California Wind Energy & PIER Research

Staff Workshop: Research Breakthroughs

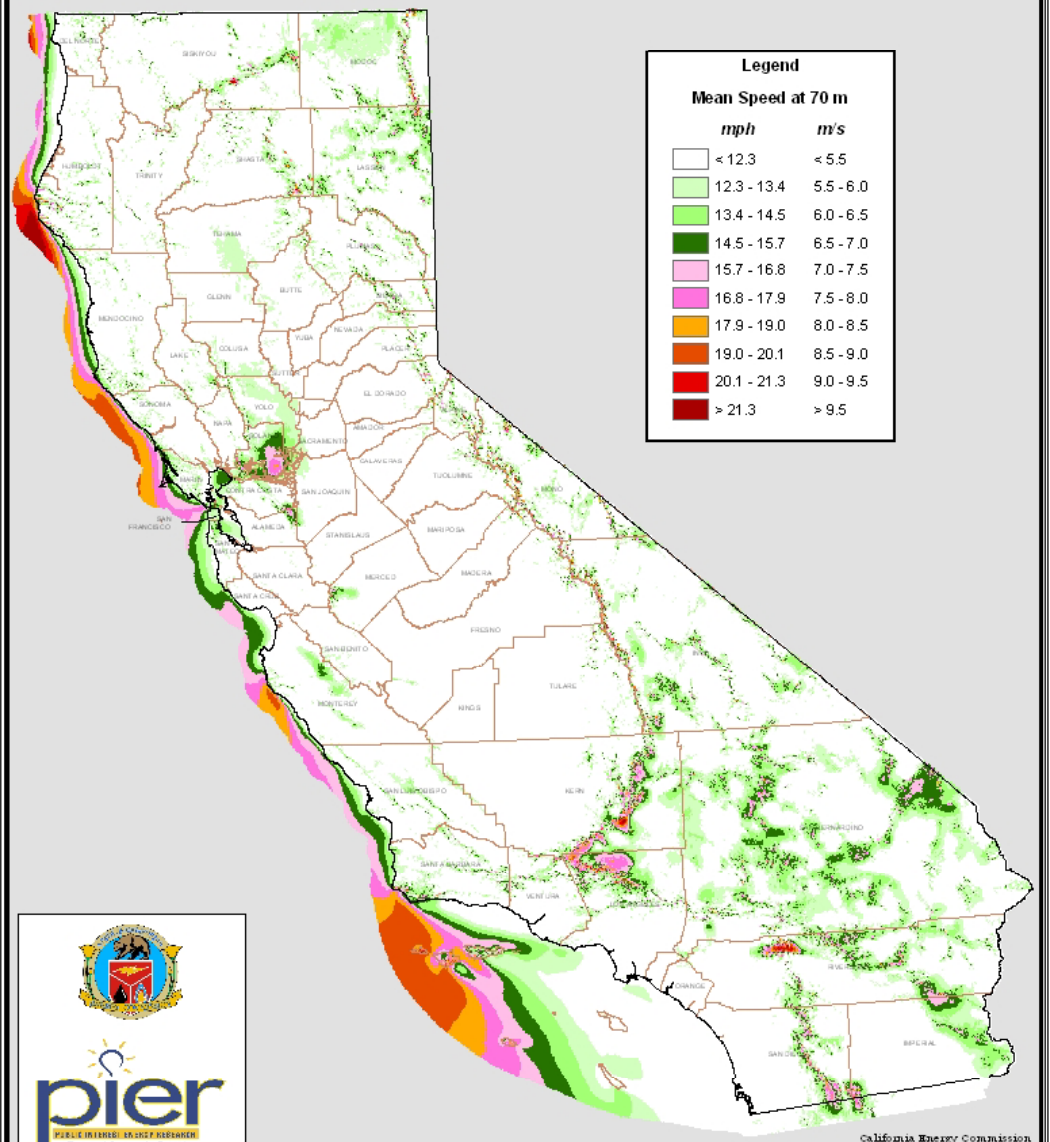
February 29, 2012

John Hingtgen
Energy Generation Research Office
Energy Research & Development Division
jhingtge@energy.state.ca.us
916-327-1434

PUBLIC INTEREST ENERGY RESEARCH
"Research Powers the Future"

California Wind Resources

Annual Wind Speed at 70 Meter Elevation



pier

This map was created by AWS TrueWind Solutions using the Mesomap system and historical weather data. Although it is belived to represent an accurate overall picture of the wind energy resource, estimates at any location should be confirmed by measurment. Data current 2006

California Energy Commission
Facilities Siting Division
Cartography Unit
www.energy.ca.gov

To inquire about ordering this map or information on other types of maps call the map line at (916) 654-4182 or
E-Mail: JGILBREA@ENERGY.STATE.CA.US

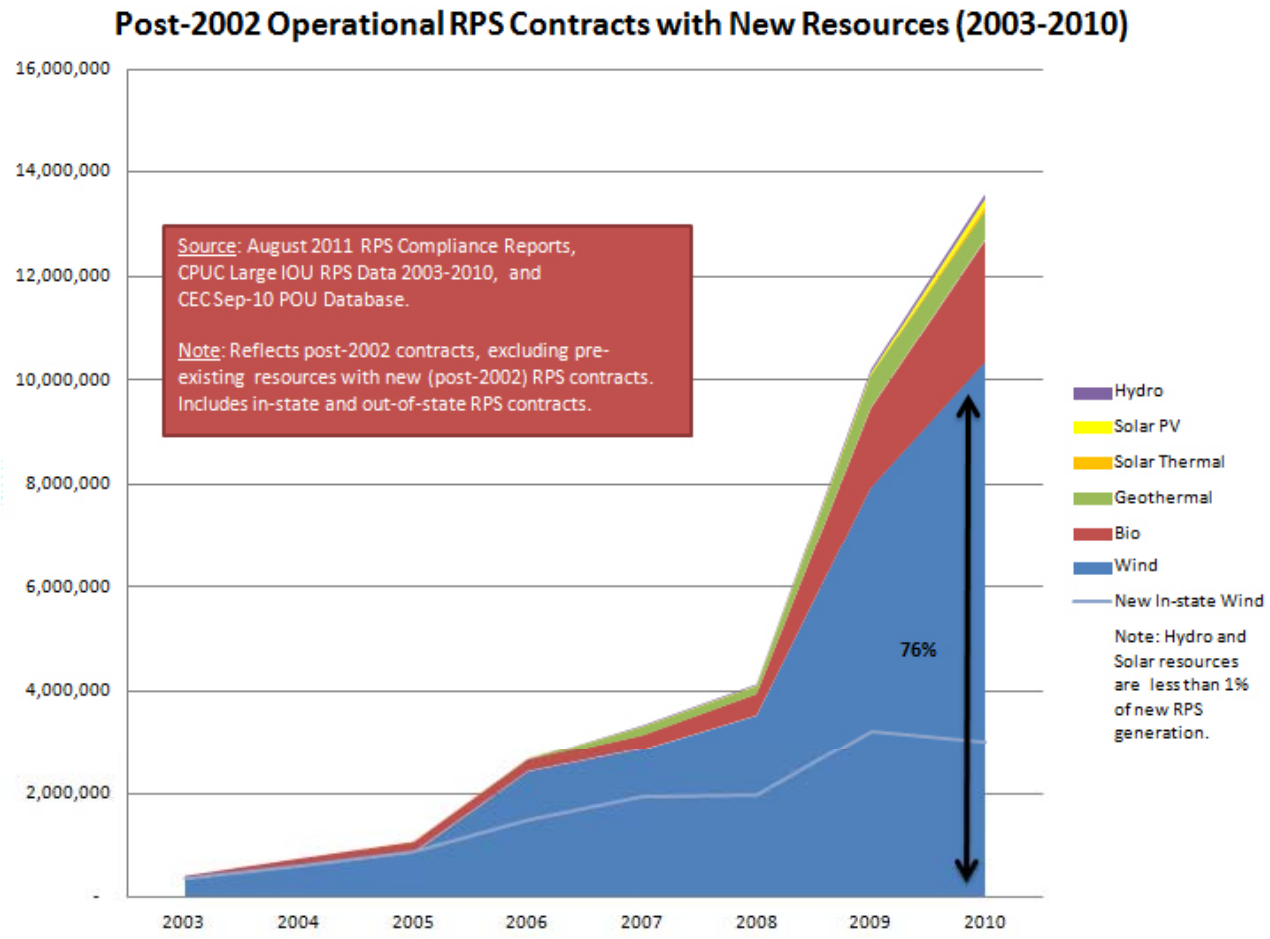
Wind Energy Resource & System Electricity

Electric Energy	GWh / yr.	% of resource
California wind energy resource (net of exclusion areas) Onshore: 47,000 + Offshore in <= 50 m water: 50,000 (current technology) + Offshore in 50 - 200 m water: 462,000 (developing technology)	559,000	100
2010 California system generation (all sources with imports)	290,187	52
2010 California in-state generation (all sources)	205,018	37
RPS- 33% of 2020 mid-demand case forecast (renewable sources)	103,000	18
2010 California system wind generation (with imports)	13,536	2
2010 California in-state wind generation	6,172	1

California Installations

- On-line: 3,927 MW (3rd in nation)
  - 921 MW added in 2011. (Most new installation of any state)
- Under construction: 847 MW
- In-queue: 18,000 MW
- Percent of CA energy generation (2010)
  - In-state: 3.0%
  - With imports: 4.7%
- 15 manufacturing facilities around the state
  - Several major manufacturers making turbines, towers
- Total jobs in 2010: 4,000-5,000
- Economic activity
  - Annual property tax payments by owners: >$22M
  - Annual land lease payments: $12M
- Avoid 7 M metric tons/year of CO2

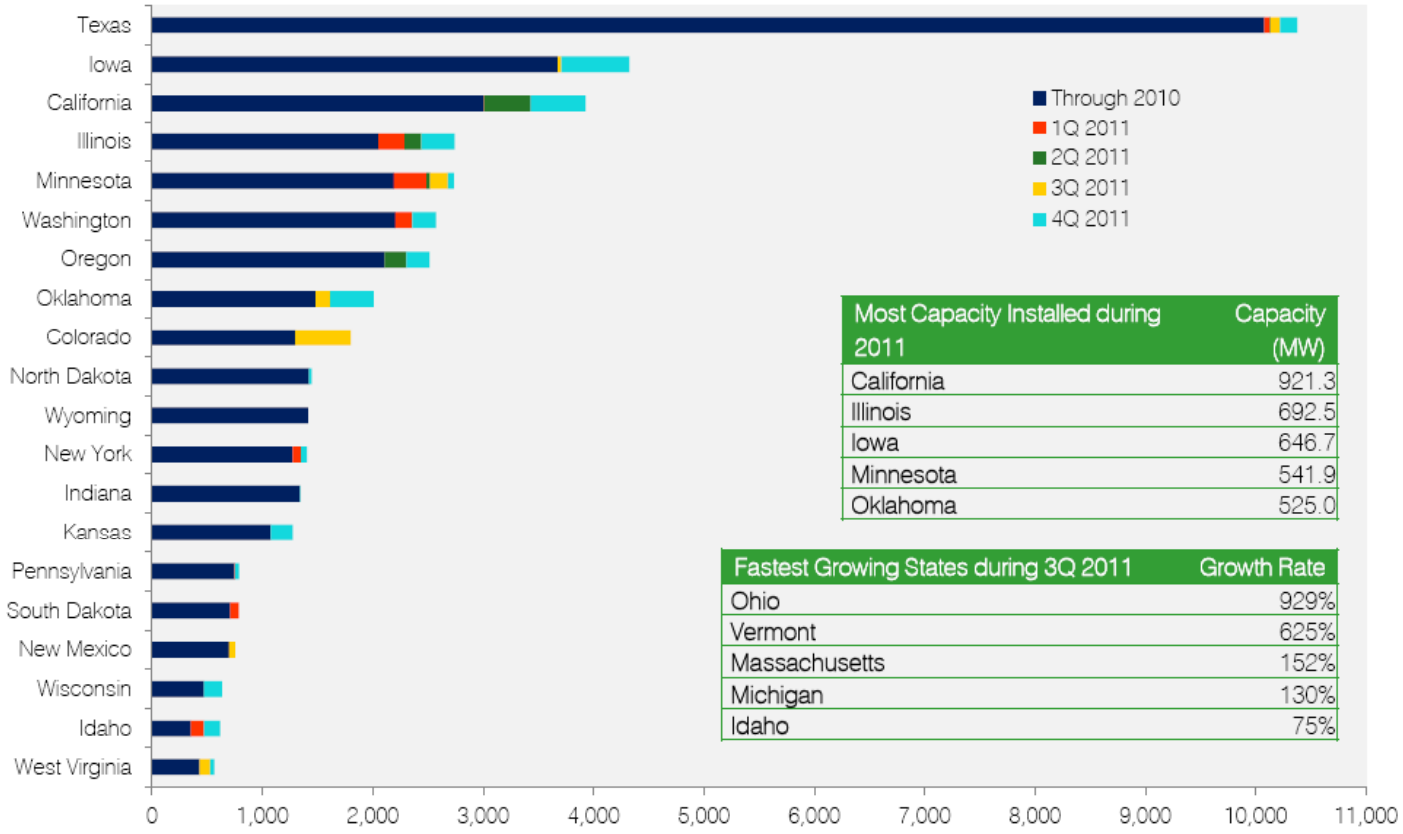
Recent RPS Contracts



Source: CWEA, based on CPUC & CEC data

PUBLIC INTEREST ENERGY RESEARCH
"Research Powers the Future"

Wind Power Capacity Installations, Top 20 States



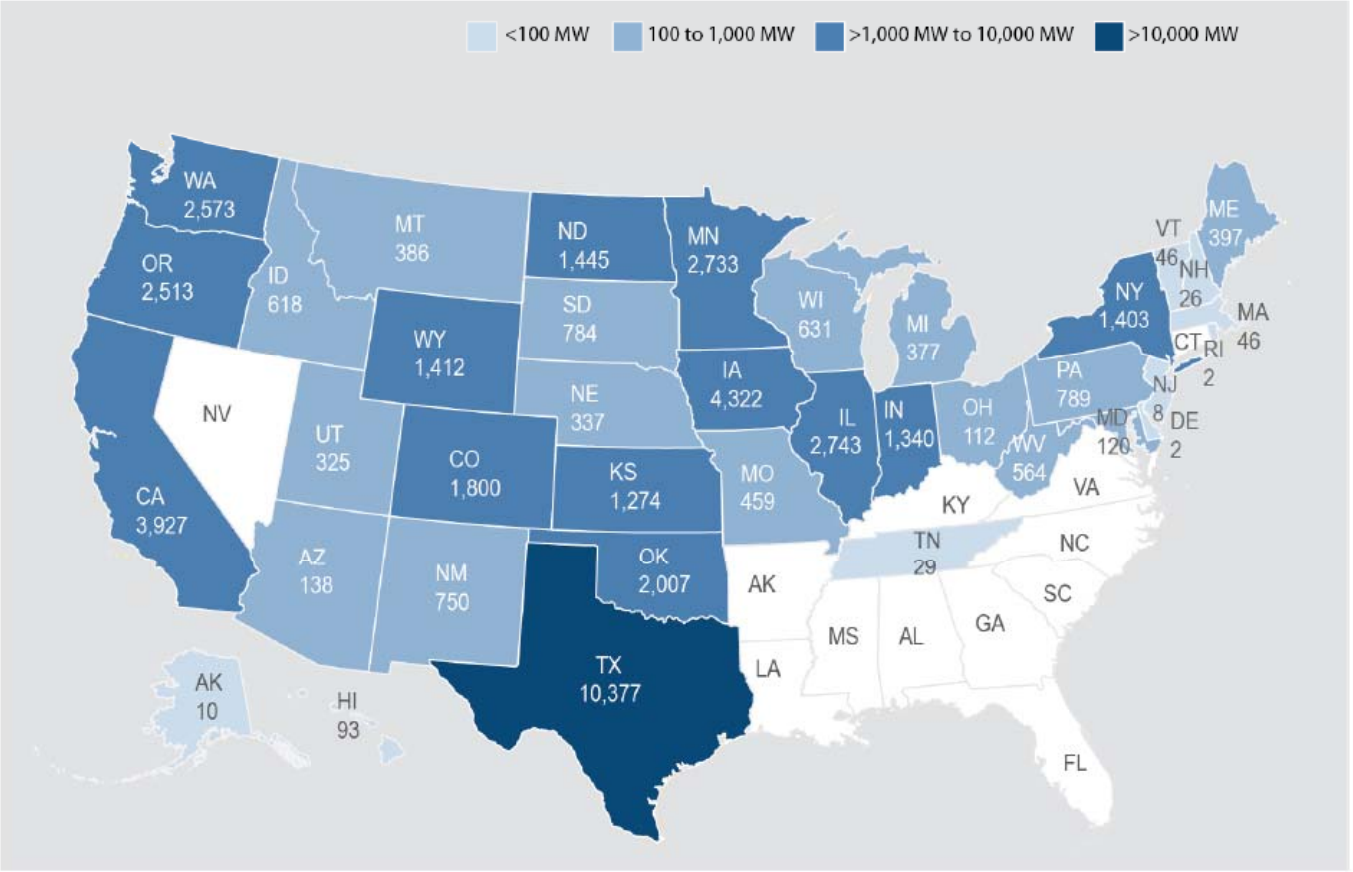
Most Capacity Installed during 2011	Capacity (MW)
California	921.3
Illinois	692.5
Iowa	646.7
Minnesota	541.9
Oklahoma	525.0

Fastest Growing States during 3Q 2011	Growth Rate
Ohio	929%
Vermont	625%
Massachusetts	152%
Michigan	130%
Idaho	75%

Source: AWEA, 2012

PUBLIC INTEREST ENERGY RESEARCH
"Research Powers the Future"

U.S. Wind Power Installations by State



Source: AWEA, 2012

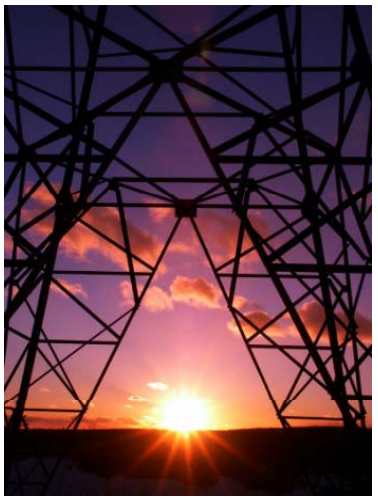
Resource Assessment

- Wind energy resource maps, 2002
- Wind performance reporting system, 1985-2003
- San Francisco wind resource assessment, 2004
- Wind anemometer loan program protocol, 2005
- California wind resources survey & potential estimates, 2005
- Regional wind forecasting system to develop & test next-hr. & next-day algorithms, wind-tunnel tests, & empirical modeling of Altamont Pass, 2006
- Wind energy resource modeling & measurement program to collect high-quality data at modern heights, 2006
- Estimating generation trends in the Solano resource area using public data, unpublished
- California renewable energy forecasting review & recommendations for enhanced forecasting, 2010
- Expanded Sodar monitoring & wind measurement in the Tehachapi / Mojave resource area, in press

Generator & Storage Design

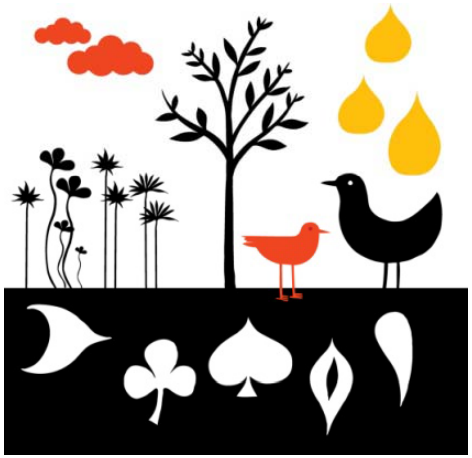
- Development of optimum design & performance for VAWT, 2005
- Improving the value of wind generation through back-up generation & energy storage, 2005
- Assessment of battery and H storage systems integrated with wind resources in California, 2005
- Distributed generation drivetrain for turbine applications, 2006
- Build & test a 3 kW co-axial, multi-rotor turbine & assess, 2007
- Wind-storage-enhanced transmission research & development to examine storage options at sites and identify best storage sizes & types, pub. 2011
- Composite taller towers for low to moderate wind shear, unpublished

Electric System Integration



- Intermittent wind generation summary of impacts on grid operations, 2004
- Strategic value analysis of system economic benefits of wind (& other RE) generation in strategic locations, 2005
- Wind power generation trends at major resource regions & comparison to system electrical demand, 2005
- Impact of past, present & future turbine technologies on transmission system operation & performance, 2006
- Intermittency analysis project on impacts of higher levels of intermittent generation on the electric system in case studies, development of methods to evaluate renewables & conventional generation, 2007
- Evaluation of wind & solar generation, & storage impact on the California grid, 2010

Environmental Effects



- FAA lighting standards for wind plants, 2005
- Permitting setbacks for turbines in California, 2005
- Improved tools & methods to determine risk
- Operation & siting locations to reduce mortality
- Improved accuracy of mortality estimates
- Avian guidelines to avoid bird & bat impacts, 2007

New R & D Studies

- Feasibility assessments for co-located geothermal, solar, wind, and biomass resources in the L.A. basin
- California off-shore wind technology assessment
- California off-shore wind energy forum
- Research results forum for geothermal, solar, wind, biomass, and small hydropower

Discussion Questions

- What new R&D can help address integration challenges as wind capacity increases?
- How are storage needs different for wind and solar generation, and what research is needed to address these differences?
- What R&D can provide a significant contribution toward expanding California's wind energy production?
- What will prove to be the most significant environmental impacts of wind generation over time in California?